Beit Issie Shapiro
Changing the lives of people with disabilities
On the Willie & Celia Trump Campus

# Sensing the world: On the familiar and the hidden senses

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This article will discuss the senses and the way in which we use them in order to obtain information from the environment. In another article, I will relate to the subject of "sensory processing disorder", which is also known by a variety of other names – sensory integration dysfunction, sensory regulation disorder, hyper-responsiveness, hyper-sensitivity, or hypo-sensitivity.

In order to understand the disorders that may occur in the sensory system, we first need to understand what the senses are and how they operate, and what sensory integration is – the process in which our brain receives sensory stimuli from the environment, processes and interprets them, and produces a response.

## What is a sense?

A sense is the ability of a living being to receive information from the environment, and convert it in a manner that is absorbed and processed by the brain. In order for a stimulus to acquire meaning, our brain has to process and interpret the information.

Information from the environment is absorbed by means of sensors (receptors). A sensor is a cell in the body whose role is to take in information, and pass it on by means of the nervous system. Each type of information – whether it is sound, vision, taste, smell, or flavor – has its own sensors that detect the information. This information reaches different parts of the brain, where it undergoes processing, interpretation, and storage for future use.

Without this processing, the information will remain a collection of meaningless data. This can be compared to reading – if we cannot identify the letters, they are merely a collection of meaningless lines. We can only obtain information from them if we know how to interpret them.

We tend to see our senses as being self-evident. In fact, we usually only notice them when something is wrong – for example, when we have a cold and we lose our sense of smell, suddenly our food also loses its taste…

Here are a few interesting facts about the senses:

## Sense of hearing

- The sense of hearing works by means of sound waves hitting the eardrum. The auditory bones move as a result of these waves, and their oscillations are transferred to the part of the ear called the “cochlea”. These oscillations create nerve signals that reach the brain through the vestibulocochlear nerve.
- The different signals reach different parts of the brain, which is able to identify the intensity and source of the sound according to the area from which it comes.
- The sensors for this sense are located in our inner ear.
- The auditory bones are the smallest bones in the human body.
- In the sixth month of pregnancy the fetus can already detect sounds, and in fact even expresses a preference for human voices over music.
- The sounds that we hear are measured according to their height and strength. The height of the note is determined by the number of oscillations it creates in a second – the greater the number of oscillations, the higher the note; the strength of the note is determined by the force with which the sound waves “hit” the eardrum.
- The sense of hearing continues to work even while we sleep.

## The sense of sight

- In order to see, we need a certain amount of light. The light particles hitting the molecules in our eyes cause a sensory stimulation that is transmitted to the center of sight in the brain.
- At 33 weeks, the fetus can already distinguish between light and dark.
- At birth, the baby is capable of seeing to a distance of around 20 cm – the distance from the mother’s arms to her face.
- The sense of sight continues to become sharper after birth, and at the age of six months the baby’s sight is similar to that of an adult.
- The sense of sight is the most active of human senses. We get around 60% of our sensory information through our eyes.

## The sense of smell

- The sensors of the sense of smell are cells existing in the nasal tissue. Changes in the concentration of substances in the air cause these cells to transmit neural information to the olfactory center in the brain.

- There are around a thousand different types of olfactory sensors, capable of distinguishing some 10,000 different smells.
- Each sensor in the nose lives for around sixty days, and is then replaced by a fresh, new sensor, as part of the body's regular process of renewal.
- Smell contributes around 70% of the taste of food – so when we have a cold and cannot smell, we also hardly notice the taste of the food.
- Women have a more sensitive sense of smell than men.
- Amniotic fluid contains around 120 different smells.
- Babies are already able to identify the smell of their mother and her milk when they are just a few days old.
- The neural pathway of the sense of smell passes through the center in the brain that is responsible for processing emotions; as a result, smells arouse strong emotions in us, and are also capable of prompting memories. The sense of smell stores its information for a very long time relative to the other senses.

## The sense of taste

- The sensors for the sense of taste are in the tongue, the inner part of the cheeks, the throat, and the upper palate.
- There are different sensors for different tastes – bitter, sweet, salty, sour.
- Each taste plays a role in survival: the sweet taste identifies food providing us with energy; the bitter taste warns us against poisons; the salty taste allows us to identify substances to maintain the balance of salts in our body; and the sour taste warns us against spoiled food.
- "Spicy" is not a taste, but a sensation of burning on the tongue.
- The sensors of the sense of taste are replaced every 10 days.
- The fetus is able to distinguish different tastes in the amniotic fluid, which vary according to the mother's nutrition.
- The number of taste buds continues to grow after birth, so that the baby learns to identify additional tastes.

## The hidden senses

The four senses reviewed so far are ones that we are very familiar with. The fifth sense, the sense of touch, actually belongs to the "hidden senses". These act in our body in a similar way to the other senses – that is, by stimuli received by sensors and processed by the brain – but we are less aware of them. Apart from the sense of

touch, the “hidden senses” also include the vestibular sense – the system of balance, and the proprioceptive sense – the sense of self movement and body position.

## The sense of touch

- The sense of touch is in fact a system called the “tactile system”. This system transfers information received from sensors on the skin. The sensors absorb information on touch, pressure, texture, temperature, and pain, and transmit them to the brain.
- The brain filters the stimuli so that we only feel part of them; for example, we stop feeling the touch of clothes on our body after a short time, because the stimulus is not important for our survival and learning.
- The sense of touch is the first sense to develop in the fetus, already in the eighth week of pregnancy.
- The skin is the largest organ in our body.
- Touch is vital not only for learning and survival, but also for motor, physical, and emotional development.
- In different parts of the body there are differing numbers of sensors; the back, for example, has few sensors while the fingertips, which we use for touch, have many sensors crowded together.

## The vestibular system

- This is the system of balance. It is located in the inner ear, and measures changes in the body’s position and position of the head. The system works by means of semicircular canals filled with fluid that moves with movements of the head, and as a result sends neural stimuli to the brain.
- The stimuli received from this system enable the brain to know the location of the body relative to the force of gravity, whether it is in motion or at rest, and the direction and speed of movement.
- This system has two main roles: to carry out corrections to our balance as the body moves, and to adjust our eye movements to the movements of the body and head, so that even in motion, for example while walking, we continue to receive a stable picture of the world around us.
- The system of sight is also connected to the vestibular system, because we also use our sense of sight to maintain a steady body position.
- The soles of our feet transfer information to the vestibular system so that the brain can calculate what changes are required to our body’s position and muscle action in order to maintain our balance while walking and standing on different surfaces.

- "Sea sickness" occurs when the system of sight transmits one kind of information to our brain (a stable picture), as against another kind of information (movement) obtained from the vestibular system.

## The proprioceptive system

- This system provides us with information on "where and what" – where the parts of the body are, and what they are doing. For example, if we close our eyes we can extend a finger and touch our nose; we can raise an arm, or make a movement – because this system provides us with information at any given time that allows us to identify where our finger is relative to our nose.
- This system enables us to know how to make an effective and efficient movement. For example, if we want to pick up a cup, the system will tell us how far to extend our hand, with what speed and force, how firmly to close our fingers around the cup, and the speed with which to pick it up in order to bring it to our mouth.
- The system has sensors in the tendons, muscles, connective tissues, and joints, transmitting information with regard to the position of the parts of our body and their movement.
- Thanks to the actions of this system we have a "body scheme" – a kind of imaginary picture of our body, its size and volume, and the place it occupies in space.
- Information from the system is received during movement, but also at rest. For example, when we wake up we know where each part of our body is, and in what position, without needing to look at and examine it.
- When the system operates properly, we can carry out many actions automatically without needing to pay attention to them: getting dressed, washing, writing, and so on. The system has created a pattern of movement for us that we are familiar with, and we are able to carry it out without giving it special attention, allowing us to focus on other things such as motor and cognitive activities, and so on.

## What is sensory integration?

Each sense is important; but only the combination of all of them together will give us a full picture of the world around us. The combination of the information obtained from the different senses is called **sensory integration**: a process in which the stimuli from the different senses obtained in the brain undergo processing, interpretation, and storage, and an appropriate motor, physiological, or emotional response is created.

Let us take as an example a basic activity such as eating. When we give an infant a meal, the different senses work together to allow him or her to learn and experience the activity:

- The sense of smell provides information about the type of food
- The sense of sight gives information about the appearance of the food, its color and texture
- The sense of taste provides information about the taste of the food
- The sense of hearing gives information about the sounds related to preparing and serving the food, such as the dishes being placed on the table and the words of the carer, telling him or her the name of the food or its taste
- The sense of touch gives information about the texture of the food, its temperature, and the texture of the dishes
- The sense of balance allows the child to remain sitting upright in the chair while putting out a hand towards the food, and raising the hand with the spoon to his or her mouth
- The proprioceptive sense allows the child to know how firmly to hold the spoon, where to extend his or her hand, and how to put the fork into the food.

The combination of the senses together creates the full experience of eating and familiarization with the food. The brain processes the stimuli, interprets them, stores them together with previous experiences, and files them away for use in the future. In this way, for example, the baby will remember next time that the word “apple” relates to a particular smell, texture, and taste; and knows that eating an apple requires the use of a particular strength in his or her mouth, and grasping the apple with a particular force.

Effective sensory integration therefore allows us to function efficiently in the world, diverting resources to survival or learning, and using different motor skills smoothly, and in accordance with the requirements of the stimulus and the environment.

More about sensory modulation disorders and the way in which they are expressed – Read here